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Yu, Liyun; Madsen, Frederikke Bahrt; Zakaria, Shamsul Bin; Skov, Anne Ladegaard

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# Silicone elastomers with superior softness and dielectric properties

Liyun Yu, Frederikke Bahrt Madsen, Shamsul Bin Zakaria, Anne Ladegaard Skov\*

The Danish Polymer Centre, Department of Chemical and Biochemical Engineering,  
Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

\*Corresponding author: Tel.: +45 45252825; Fax: +45 45882258. E-mail: al@kt.dtu.dk

Dielectric elastomers (DEs) change their shape and size under a high voltage or reversibly generate a high voltage when deformed. The obstacle of high driving voltages, however, limits the commercial viability of the technology at present. Driving voltage can be lowered by decreasing the Young's modulus and increasing the dielectric permittivity of silicone elastomers. One such prominent method of modifying the properties is by adding suitable additives.<sup>[1]</sup> The major drawbacks for adding solid fillers are agglomeration and increasing stiffness which is often accompanied by the decrease of electrical breakdown and achievable strain.<sup>[2]</sup>

In this work, three liquid additives - inert silicone oil, chloropropyl-functional silicone oil, and synthesized chloropropyl-functional copolymer - were blended into commercial silicone elastomers, and their properties were investigated.

The functional groups were determined by NMR and morphology structures were investigated by optical microscopy. The resulting elastomers were evaluated with respect to their dielectric permittivity, tear and tensile strengths, as well as electrical breakdown.

The breakdown strength increased at low amounts of additives whereas it decreased at larger amounts. The elastomers became increasingly soft with increasing addition of soft filler. Both inert and chloropropyl-functional silicone oils enhanced the molecular motions of the network substructures via dynamic dilution effects but the viscous losses also increased with increasing amount of silicone oils. Cross-linkable chloropropyl-functional copolymer offered a high level of mechanical integrity of the blended elastomers thus consequent low viscous losses.

The dielectric permittivity of chloropropyl-functional blended elastomers increased greatly compared to the pristine commercial elastomer, while the dielectric losses remained at a low level. The increase in dielectric permittivity stemmed from the high dipole moment of the chloride groups. Furthermore, the alkyl chloride units yielded a larger free volume resulted in a less dense material with a lower Young's modulus.<sup>[3]</sup>

**Keywords:** silicone elastomer, Young's modulus, dielectric permittivity, electrical breakdown, silicone oil, chloropropyl-functional

## References

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